MORTALITY UNDER INDIVIDUAL IMMEDIATE ANNUITIES

A. What conclusions can be drawn from the 1954 Committee Report?
B. Are the present bases and valuation standards for individual annuities and settlement options satisfactory?

MR. W. A. JENKINS felt that one of the most interesting and important aspects of this committee report on annuity mortality is the question of how rapidly mortality rates are decreasing. In particular, are they decreasing as projected by Scale B, or more slowly, or more rapidly?

In Tables 6 and 7, the Committee shows mortality ratios for the three periods in a form convenient for analyzing trends. The committee states that the general downward trend in mortality ratios brought out in the previous report is evident in the current experience and is fairly consistent through all three periods.

For comparison, Mr. Jenkins calculated what the mortality ratio reductions for the various groups in Tables 6 and 7 would have been if Scale B had prevailed. The following table shows the over-all annual rates

CLASSIFICATION		By Numbers		By Amounts	
		Tabular Scale B	Actual	Tabular Scale B	Actual
Nonrefund { Male........		0.6%	1.5%	0.5%	1.1%
Nonrefund { Female.......		0.6	1.1	0.5	1.1
Refund { Male........		0.6	0.7	0.6	1.8
Refund { Female.......		0.6	0.6	0.6	0.6

of reduction for all ages and durations combined for both Scale B and the current experience on the same basis as the committee's "all ages, adjusted" ratios in Tables 6 and 7. Because the results for all durations combined were about the same as for durations 6 and over, the select portion of the experience was not omitted. Because of irregularities between periods 1 and 2 and between 2 and 3, period 1 was compared with period 3 giving a broader spread of years and smoother results.

Indications from this table are as follows:

1. For all nonrefund annuities—for both sexes and by numbers and amounts—the over-all annual rate of mortality improvement was approximately double that indicated by Scale B.

2. For female refund annuities—both by numbers and by amounts—the over-all annual rate of mortality improvement was the same as that under Scale B.

3. For male refund annuities the over-all annual rate of mortality reduction was about the same as that indicated by Scale B by numbers, but by amounts the rate of decrease was three times that derived from Scale B.

Considered as a whole, these figures indicate clearly that mortality rates have been declining somewhat more rapidly than Scale B over the years in question, *i.e.*, from the period 1941–46 to the period 1948–53.

Analysis of Tables 6 and 7 in another way indicates that the annual rates of mortality decrease below age 80 for both types of annuity and both sexes combined have been a little less than those in Scale B, and that practically all of the excess mortality improvement was at ages 80 and over. The over-all mortality improvement assumed under Scale B for ages 80 and over was about one-fourth of 1% per year whereas the actual rate of improvement for these ages appears to have been nearly seven times that high. Thus, instead of the rate of improvement decreasing above age 80, as assumed in Scale B, the improvement rate actually increased above age 80. The following table shows the actual annual rates

| | By Numbers | | By Amounts | |
Attained Age	Tabular Scale B	Actual	Tabular Scale B	Actual
60–69.................	1.1%	0.7%	1.1%	0.6%
70–79.................	0.8	0.4	0.8	0.9
80 and over...........	0.2	1.3	0.2	1.5

of mortality improvement and the tabular Scale B rates, combining both sexes and both types of annuity. Data under age 60 were omitted as being too small and irregular.

To gauge the possible import of this type of mortality change, the following table shows the percentages by which nonrefund male life annuity values are increased by the mortality decreases provided by Scale B at ages 80 and over:

Age (x)	$_{19 50}\bar{a}_x$	Increase	Percentage Increase
55........	17.336	0.069	0.40%
65........	12.744	.065	.51
75........	8.395	.050	.60
85........	4.927	.004	.08

From this table it may be deduced that if the experience of the last few years continues and mortality improvements at ages 80 and over are, say, seven times those stated in Scale B, a nonrefund life annuity value at age 65, calculated according to Scale B, should be increased still further by about 3%. At younger ages, the increase would be somewhat less and at higher ages, up to 75 at least, a little larger.

Mr. Jenkins pointed out that the flatness of the mortality decrease rates by age in the current experiences suggests that a flat percentage might be appropriate in the future. He said that the annual rate of approximately 8/10 of 1% used by Mr. Duncan Frazer in connection with the British tables about 30 years ago and the 1% rate which he himself used in his 1946 paper were not far different from the actual rates experienced. However, it is most important to realize that the above-indicated trends might be temporary, since the long history of mortality changes is noted for the irregularities it has shown.

In view of the trends shown by the committee report for ages 80 and over and the large exposure at these ages, future committee reports would be more informative if this age group were divided at least into two groups, for ages 80 to 89 and ages 90 and over. This has been done for the 1948–53 data, so that in the future we can see if there is any improvement over age 90 and the degree of improvement in the important 80 to 89 age group.

MR. W. J. NOVEMBER also commented on the continuing mortality improvement shown by the current report and said that not to take this into account in establishing an actuarial basis for income contracts is simply burying one's head in the sand.

The following table shows the annual geometric rate of decrease in the mortality ratios (based on the 1937 Standard Annuity Table) over the seven year interval between the current experience and the 1941–46

ATTAINED AGES	AVERAGE ANNUAL RATE OF DECLINE BETWEEN 1941–1946 AND 1948–1953 EXPERIENCE PERIODS				AGE	JENKINS-LEW PROJECTION SCALES	
	Nonrefund		Refund			A	B
	Males	Females	Males	Females			
60–69......	5.1%	1.7%	1.3%	0.2%	65....	1.0%	1.10%
70–79......	−0.0	0.9	−0.0	0.7	75....	.6	.75
80–89......	2.2	2.0	2.1	1.1	85....	.2	.25

study. Durations under 6 were excluded to eliminate the effect of any changes in selection practices. Only the age groups with the most significant volume of data are shown and comparison is made with the Jenkins and Lew Projection Scales A and B.

This table shows that the decreases for ages 60–69 and 80–89 are well in excess of Scales A and B. Mr. November said the experience of his own company was quite similar to that of the current report.

The experience at ages 80 and over should command the attention of the actuarial profession. Although the a-1949 Table was designed to be conservative at the end of 1949, the current experience shows that for all subgroups over age 80 for nonrefund annuities, and for most subgroups over 80 for refund annuities, the mortality ratios based on the a-1949 Table are under 100%.

Another important aspect of the findings at high ages is the downward slope in the mortality ratios based on the a-1949 Table. This is illustrated by pertinent ratios taken from Tables 1 to 5 of the report and shown below.

MORTALITY RATIOS IN 1948–53 EXPERIENCE, BY NUMBER OF CONTRACTS
ALL DURATIONS COMBINED

ATTAINED AGES	BASED ON a-1949 TABLE				BASED ON 1937 STANDARD ANNUITY TABLE			
	Nonrefund Ann.		Refund Ann.		Nonrefund Ann.		Refund Ann.	
	Males	Females	Males	Females	Males	Females	Males	Females
50–59	98%	110%	128%	144%	76%	57%	100%	75%
60–69	90	102	126	125	73	66	102	80
70–79	108	104	120	111	98	90	108	96
80–84	88	99	104	109				
85–89	90	96	95	105	95	116	104	127
90 and over	89	94	78	100				

Any tables derived from the a-1949 Table must be accompanied by careful analysis of future trends because of the aging process in annuity business. For example, due to this aging, the actual number and amount of deaths in the 1948–53 experience were considerably *greater* than those in the 1941–46 experience although both the exposures and the death rates were slightly *lower* in the 1948–53 experience.

The current report indicates that there was a greater degree of selection under nonrefund annuities than in the 1941–46 study. No such

change in initial selection factors appeared under refund annuities. The
following table compares, for all ages together, the relationship for non-

	1948–53 Experience	1941–46 Experience
Male Lives		
Durations 1 and 2......	70%	83%
Durations 3 to 5........	80	93
Female Lives		
Durations 1 and 2......	47	56
Durations 3 to 5........	65	82

refund annuities of the mortality ratios for earlier durations to those for
durations 6 and later for the two studies.

MR. L. H. McVITY said that if the a–1949 Table, or a projection
thereof, is to be widely adopted for annuity gross premiums, it would be
highly desirable to be able to use the same table as a reserve basis rather
than have to compare reserves periodically with the minimum standards
of the various states. He presented the accompanying table showing the

MINIMUM STATE VALUATION BASES FOR ANNUITIES
CURRENT ISSUES

No Applicable Law

Alabama	Connecticut	Iowa	South Carolina
Arkansas	Georgia	Nevada	South Dakota
Colorado	Idaho	North Dakota	Utah

1937 Standard Annuity & 3% Interest
New York

1937 Standard Annuity & 3½% Interest

California	Maine	Nebraska	Pennsylvania
Delaware	Maryland	New Hampshire	Tennessee
Dist. of Col.	Massachusetts	New Jersey	Vermont
Illinois	Michigan	New Mexico	Virginia
Indiana	Minnesota	North Carolina	Washington
Kansas	Mississippi	Ohio	West Virginia
Kentucky	Missouri	Oregon	Wisconsin
Louisiana	Montana		

American Experience 3½%

Arizona	Oklahoma	Rhode Island

McClintock's 4%
Wyoming

Any Recognized Basis Approved
Florida   Texas

minimum annuity reserve basis prescribed by the various states and then used a block of the Equitable Society immediate life annuities to compare reserves on various bases. The annuities tested involved $1,490,000 annual income on male lives and $4,246,000 on female lives. The reserves for this block of annuities totaled $48.4 million on the a–1949 Table with 3% interest and $50.1 million with $2\frac{1}{2}$% interest. The reserves by the New York statutory minimum of 1937 Standard Annuity with 3% interest were $50.3 million, so that even the $2\frac{1}{2}$% reserves on the a–1949 Table would not be sufficient. The most stringent reserve basis prescribed by states other than New York is the 1937 Standard Annuity Table with $3\frac{1}{2}$% interest and on this basis reserves totaled $48.6 million, so that the a–1949 Table would be satisfactory with a $2\frac{1}{2}$% interest rate but not with 3%.

MR. JULIUS VOGEL commented on the average annual income per contract contained in the current report. For attained ages 50 and up and for all ages combined, annuities on males are larger than on females. Also, with only minor exceptions, nonrefund annuities were larger than refund annuities. A review by issue age and duration reveals that recently issued annuities are larger than older issues and that the size of the annuity on male lives increases with issue age.

Mr. Vogel calculated reserves on a representative block of nonrefund annuities on the 1937 Standard Annuity Table with and without a one-year age rating and on the a–1949 Table with and without projection B to see whether current mortality improvements have outmoded current valuation bases. A comparison of immediate annuity values indicates that at the lower ages values on the 1937 Standard Annuity Table with or without age rating are somewhat lower than values based on the a–1949 Table with or without projection. About attained age 70, the situation is reversed and for higher ages the values based on the 1937 Standard Annuity Table are higher than those obtained from the a–1949 Table.

Using the age and sex distribution of nonrefund annuities contained in the 1954 report, a weighted average immediate annuity value was obtained for total male exposure, total female exposure, and male and female exposures combined, on several interest rates varying from 2% to 3%. For all of these interest rates, the aggregate annuity reserves on the 1937 Standard Annuity Table rated down one year exceeded the reserves on the a–1949 Table with projection B, with the excess being about $2\frac{1}{2}$% for males, $6\frac{1}{2}$% for females and $5\frac{1}{2}$% for males and females combined. For male lives, the reserves on the 1937 Standard Annuity Table without age rating were almost identical with those on the a–1949 Table without projection but $1\frac{1}{2}$% smaller than reserves on the a–1949 Table with projection B. For female lives and for male and female lives combined, aggregate reserves on the 1937 Standard Annuity Table without age rating

exceeded corresponding reserves on the a–1949 Table both without and with projection B.

This leads to the conclusion that aggregate reserves on the 1937 Standard Annuity Table are not less conservative than those on the a–1949 Table with projection B *provided* the distribution by age and sex is quite close to that which was obtained in the latest study. However, Mr. Vogel cautioned that it did not require much of a change in this distribution to result in smaller reserves on the 1937 Standard Annuity Table than on the a–1949 Table with projection; and if a company has a lower than average age on its annuity business, it may be desirable for that company to consider adopting a more modern table than the 1937 Standard Annuity Table for its reserves or else consider the use of rating in age or interest rate differentials with that table. Since the single premium nonrefund annuities are probably the most select group of annuities, it is probable that the 1937 Standard Annuity Table has not yet been outmoded for valuing other classes of annuities.

MR. J. C. NOBACK set out two important conclusions he reached in studying the 1954 report. Firstly, the a–1949 Table was a good measure of mortality experience in the calendar year for which it was devised. Perhaps its rates of mortality at ages above 85 should have been lower. He quoted mortality ratios from Tables 3, 4, and 5 of the report to support his conclusion. His second conclusion was that mortality improvement has been accelerating so fast that both of the Jenkins-Lew projection scales are now out of date. Mortality ratios from Tables 6 and 7 clearly point up this improvement.

Mr. Noback then calculated the percentage improvement in mortality shown by the latest experience, graduated the results; the following table

PERCENTAGE IMPROVEMENT IN MORTALITY—ANNUAL RATE

ATTAINED AGE	JENKINS-LEW		1954 COMMITTEE REPORT ROUGH GRADUATION	EXCESS OVER PROJECTION B
	Projection A	Projection B		
65..........	1.0%	1.10%	1.50%	0.40%
70..........	.8	.95	1.33	.38
75..........	.6	.75	1.17	.42
80..........	.4	.50	1.00	.50
85..........	.2	.25	.83	.58
90..........	.0	.00	.67	.67
95..........	.0	.00	.50	.50
100..........	.0	.00	.33	.33
105..........	.0	.00	.17	.17
110..........	.0	.00	0.00	0.00

compares the actual improvement with that assumed in Jenkins-Lew projections A and B.

In view of the rapid improvement in mortality at the higher ages, we should consider the adequacy of our settlement option tables as a basis for settlements arising many years in the future. If this improvement continues, our settlement option guarantees should be a function of the year of birth of the beneficiary as well as of the age and sex of the beneficiary. This could be done quite readily by means of a three way table involving the year of birth, age and sex of the beneficiary, and the table need not take up more than about three square inches in the policy.

Each company should give this matter serious consideration, although it is recognized that other factors will enter into any final decision such as the persistency of policies, the settlement option utilization in the particular company and the company's attitude toward the future trend of the interest rate.

MR. E. A. LEW summarized his conclusions drawn from the 1954 Committee Report as follows:

1. The 1937 Standard Annuity Table has, in recent years, grossly overstated the ultimate death rates at ages below 70 and has furnished a reasonably conservative representation of actual experience only at attained ages 80 and over.
2. The a–1949 Table, without projection, appears to have been a good overall measure of the *ultimate* death rates experienced in recent years under nonrefund annuities and it was the ultimate experience under such annuities that this table was intended to represent.
3. Although the mortality ratio under male nonrefund annuities for attained ages 80 and over was only 92% of the a–1949 Table, the corresponding ratios for attained ages 70 to 79 were 113% by number and 127% by amount of income. The indications are that when the survivors of the males to whom nonrefund annuities were issued at about age 65 reach their eighties, the mortality in this age range will be materially increased.
4. Under nonrefund annuities issued at ages 70 or older, the effects of temporary selection have been more marked than at the younger ages and have extended over at least five years.

It is noteworthy that if the death rates at ages 85 and over from the 1937 Standard Annuity Table were substituted for those in the a–1949 Table ultimate, without projection, the value of a nonrefund annuity issued to a male age 65 would be increased by only about 1%. It, therefore, appears that in so far as adequacy of annuity values is concerned, (a) conservative provisions for future decreases in mortality and (b) fuller recognition of the more prolonged and far-reaching effects of temporary selection at the advanced ages are more important factors than the particular level of mortality rates assumed at attained ages 85 and over.

MR. ARTHUR PEDOE said that he felt none of the previous speakers emphasized what has become more and more evident since the turn of the century, the difference between the trend of the male and female mortality as shown both in population statistics and in the annuity study. He referred to page 45 of the report to show how the trend of female mortality is definitely downward on the nonrefund annuity. For males, the trend is not so consistent. He attributes the increased longevity in the 80's to man's learning to live his age and not to selection by the annuitant, as he feels that a man in his sixties cannot tell what is going to happen to him more than a year or two in advance; certainly the selection doesn't extend for 20 years.

Mr. Pedoe referred to a paper he presented in 1948 to the Centenary of the British Institute of Actuaries in which he maintained that the improvement in mortality at the younger ages continues throughout life. Contrary to the theory that substandard lives saved at younger ages will act to swell the mortality at higher ages, Mr. Pedoe pointed to the continued improvement in mortality shown by the Committee report for the highest ages. This was to be expected because vitality breeds vitality, disease breeds death.

MR. W. M. ANDERSON reviewed his company's recent changes in the premium and reserve bases for annuities. On ordinary annuities and settlement options they now use the a–1949 Table with Projection B. For group annuities, the Ga–1951 Table with Projection C is used for both premiums and reserves. Also, the staff pension fund is now on this table. In their group annuity master contracts, the premium rates are quoted with quinquennial year of birth cohorts so that there is a continuing improvement factor built into the rates. In this way, it is hoped that the same rate basis can be used on existing contracts for many years.

In the reserve process, decennial year of birth cohorts are used for both ordinary and group annuity reserves. In the case of future settlement options contained in life policies, they have not yet decided on any method to provide for mortality improvement but they still feel that their present basis is conservative enough. When they do build in a projection in the settlement options, he thinks they will vary by the year of birth of the insured. There is a close enough relationship between the average year of birth of the insured and his beneficiary to warrant this approximation and then each policy will contain just one settlement option table, but that table will vary by the birth year of the insured.

As regards the projection factors getting out of date, Mr. Anderson pointed out that even out-of-date projections are much better than none at all.